

MORPHOLOGICAL ANOMALIES OF TWO GECKOS, HEMIDACTYLUS FRENATUS  
AND LEPIDODACTYLUS LUGUBRIS, AND THE TOAD, BUFO MARINUS, ON THE ISLAND OF HAWAII

John G. Chan, Laura L. Young, Paul R. K. Chang, Charlene M. Shero and Celi Watts

University of Hawaii at Hilo, Biology Discipline

Hilo, Hawaii 96720

Structural anomalies and teratogenic defects resulting in unusual appendages and tissue growth are known to occur sporadically among reptiles and amphibia throughout the world (Chandra and Mukherjee, 1980; Elkans and Cooper, 1976; Marcus, 1981). It might be expected that similar anomalies might be seen among the herpetofauna of Hawaii.

The herpetofauna of the Island of Hawaii is made up of relatively few species (McKeown, 1978). All are introduced species (Eastel, 1981; Hunsaker and Breese, 1967; Oliver and Snow, 1953). Presently there are ten species of lizards represented by five species of geckos, four species of skinks, and a single species of the anolid lizard, Anolis carolinensis porcatus. In addition, a species of a blind snake, Typhlina bramina, is also present. Amphibians of the Big Island are represented by only two species, the marine toad, Bufo marinus, and the bullfrog, Rana catesbeiana.

We were interested in Hawaii reptiles and amphibia and their role as possible vectors for Salmonella. Studies of specimens captured from tropical and subtropical areas showed reptiles and amphibia to

be sources of salmonellae bacteria (Everard et al., 1979; Kourany and Telford, 1981; Taylor, 1968). To assess the abundance of salmonellae in the reptilian and amphibian fauna of the Island of Hawaii, a number of geckos and toads were collected and examined over a two-year period ending in the Spring, 1984.

It was during our collections that we observed a number of unusual morphological features in our specimens--particularly among the geckos. In this paper we report on various anomalies occurring in the house gecko, Hemidactylus frenatus, the mourning gecko, Lepidodactylus lugubris, and the marine toad, Bufo marinus.

#### METHODS

Geckos were collected from the walls of various buildings at various sites throughout the Island of Hawaii. The greatest numbers were collected on the University of Hawaii at Hilo campus, Keaau and downtown Hilo. All collections were made in the evening between 8-11 p.m. and brought back to the laboratory for examination and sampling. A total of 319 geckos were examined in the laboratory and several hundred more observed briefly in the field. Geckos captured during the study included four species: Gehyra mutilata, Lepidodactylus lugubris, Hemidactylus garnoti, and H. frenatus. Juveniles were not included in our study. Two species, L. lugubris and H. frenatus made up more than 95% of all geckos captured or observed.

A total of 103 toads ranging in size from small juveniles to large adults; they were collected from the Waiakea-Uka district mauka of the UH Hilo campus. Three specimens were dissected; all the rest were released after observation and cloacal sampling.

## RESULTS

### BUFO MARINUS, MARINE TOAD

A toad with a missing left hindleg that was found dead on its back on the sidewalk in the Komohana Gardens subdivision in Hilo on April 13, 1983. The toad, a young male, measured 85 mm in body length and appeared emaciated. Examination of the gut indicated that it had fed recently. Both the stomach and cloaca contained but a single food item--the long-legged ant, Anoplolepis longipes, which was mixed with incidentally ingested soil.

The toad was found in the early morning and appeared to have died only recently. The head and parotid glands were coated with mucus and the skin in the buccal area was still pliable. We believe that the toad had been foraging the previous evening, and probably because of its restricted mobility was unable to return to shelter before dawn. The nearest vegetation that might have offered shelter was some 25-30 feet away.

Examination of the toad showed that the entire left hind leg was missing. No leg stump was present nor was there any scar indicative of a wound. Further examination with the aid of x-ray showed that, indeed, the leg was missing in its entirety as evident by the absence

of any remnant of a femur. The absence of any scar tissue or bone remnant suggests the leg loss was due to some factor other than recent trauma.

The x-ray radiograph showed the pelvic girdle to have rotated substantially and there appeared to be a healed fracture of the right femur. No doubt both conditions were a result of the stress of moving about with a single hindleg. We conclude that the leg loss is a condition of long-standing and may be the result of a congenital defect or defective development at an early stage.

#### HEMIDACTYLUS FRENATUS, HOUSE GECKO

Specimen #1: male, 53 mm snout-vent length, captured at the University of Hawaii at Hilo. This specimen had an enlarged left eye--a condition known as exophthalmia. The periorbital area was notably enlarged and the affected eye appeared clouded. However, during the 6 weeks it was kept in captivity and the eye returned to normal size and clarity. The cause of the exophthalmic state remains unknown.

Specimen #2: male, 57 mm snout-vent length, captured at the University of Hawaii at Hilo. A prominent semi-hemispherical tumor-like mass, 6 mm diameter, was found on the dorsum of this specimen of H. frenatus. The animal had a notably distended abdomen, but was evidently emaciated. The skeletal structure stood out prominently. In captivity, the specimen was fed newly hatched tephritid flies and given water. The gecko appeared to feed normally, but produced shapeless, watery stools. After 28 days in captivity, the gecko died. Necropsy revealed a multifoci nodular mass involving the liver and to a lesser degree the intestines. Careful dissection showed the suspected tumor of the

dorsum to be associated with the visceral involvement through an intra-abdominal connection. The ellipsoidal shaped nodules ranged in size from 1 to 6 mm maximum length. Histological sections with H & E stains, showed the nodules to consist of a caseous necrotic mass surrounded by a fibrous capsule. Tissues immediately adjacent to the nodule showed involvement of polymorphonuclear leucocytes and lymphocytes. What was seen was a classical granulomatous inflammatory response to an injurious agent rather than the originally suspected neoplasia. In this specimen, numerous, rod-shaped bacteria were seen within the granuloma. Although bacteria were not isolated, it is presumed that a bacteria infection and the subsequent inflammation resulted in the formation of pseudotumors both in the viscera and on the dorsum.

Specimen #3: female, length not recorded, captured in Keaau.

Specimen #4: male, length not recorded, captured at the University of Hawaii at Hilo.

Both specimens possessed tails that branched at the tip. The tips for a given bifurcated tail were very similar to each other. Both tips were fully scaled and normal in appearance. It is suspected that only one of the tips possessed a vertebrae. The bifurcated tail condition may simply be a result of injury to the tip of the tail which was insufficient to break off the tail, but yet allowed the regeneration of an additional tip at the injured site.

#### LEPIDODACTYLUS LUGUBRIS, MOURNING GECKO

Specimen #1: female, 37 mm snout-vent length, captive specimen at UH Hilo. This gecko had a tail which had a zig-zag appearance.

The tail was alternately bent one way and then the other along the entire length of the tail. Kinking progressed over a period of several months and showed no reversion to the normal straight tail. Other L. lugubris specimens held in captivity have also shown this condition to a lesser degree. Outside of the laboratory, at least two geckos have been seen with slightly kinked tails.

Specimen #2: female, 41 mm snout-vent length, captured in Keaau. Perhaps the most bizarre anomaly observed in L. lugubris was a multi-lobed, bulbous multi-tip tail. The tail, which was less than one-half its normal length, measured only 17 mm and gave rise to two extra tail tips mid-dorsally. One extra tip, measuring approximately 9 mm in length, bore a lateral tapered lobe measuring 5 mm. This extra tail tip, with its lateral lobe, was held erect and curved in a gentle arch. Another tip, approximately 7 mm, was located at the extreme posterior. In addition, there was a tiny 2 mm lobe on the right mid-lateral portion of the tail. Taken altogether, this gecko had a tail with five distinct tips. It was also noticed that this specimen was missing a digit from the right hindleg. The presence of the large bulbous tail does not appear to have affected the gecko's well being. It has been maintained now in the laboratory for a number of months and still retains its astonishing tail.

#### DISCUSSION

The cause of the kinked tail in captive L. lugubris and the cause

of the multilobed tail on a wild captured L. lugubris specimen is not known. It appears, however, that the alternate bending of the tail which results in the zig-zag appearance may have an underlying neuromuscular cause. Smith and Fitzgerald (1983) described a similar alternate bending of the body in the garter snake, Thamnophis radix haydeni. The body kinking occurred only posteriorally to a small probable puncture wound at the 54th vertebra. It was suggested that injury to spinal nerves at this site might have caused a muscular dysfunction. With our gecko, no apparent injury was observed, although the affected tail was slightly darker in color and lacked some of the tail markings typical of this species. Tonal variation in regenerated tails among these geckos is not unusual, however. While we do not know the cause of the kinked tails, we believe it may be a neuromuscular pathological condition brought on by injury or the stress of confinement.

The multiple lobed tail appears also to be a regenerated tail. Besides its multiple lobes, the tail lacks normal pigmentation posterior to the caudal basal fracture plane--the point where tail autotomy normally occurs. It is possible that tissue damage at the fracture plane resulted in tail loss and subsequent abnormal tail regeneration. Such an injury might result from a predator attack.

It appears that some of the observed anomalies, such as those affecting the tail, have little, if any effect on the ability of the gecko to survive in its environment. On the other hand, bacteria infections, such as those suggested in the appearance of the pseudotumor, may be devastating to reptilian populations (Elkan and Cooper, 1976; Schmidt, 1971). What effect structural anomalies and infectious proces-

ses have on herpetofaunal populations in Hawaii is not known and deserves further study.

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